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ABSTRACT

This newsletter briefly describes present activities, projects, and publications in the areas of science education, mathematics education, and general education in Great Britain. Short articles on activities in Australia, India, and Israel are included along with descriptions of six other international activities. (DT)

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Science Education Newsletter

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Education and Science Division

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SEN No 25

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EDITORIAL

This edition of Science Education Newsletter (SEN) is the first to be issued by the reorganised Education & Science Division of the British Council. In April 1974 the Centre for Educational Development Overseas (CEDO) was merged with the Education & Science Division of the British Council.

The reorganised Division has the following departmental structure:

Divisional Control
Education Projects Department
Science & Technology Department
Higher Education Department
Broadcasting Department
Audio Visual Department
Education Information and Research Department

In future SEN will be produced and issued jointly by Education Projects Department and Education Information and Research Department as a Divisional publication.

The merger has created a larger, more coherent and more versatile grouping than before. In particular, Education Projects Department contains much of the Curriculum Division of CEDO, the British Council's Schools and Teacher Training Department and Science Education Section, as well as new elements to be concerned with further education and non-formal education.

The new Division, along with other elements of the Council's organisation will shortly move to the new British Council Headquarters. From November 1974 the address for correspondence on matters arising from SEN will be:-

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England

ACTIVITIES IN BRITAIN - SCIENCE

1. Nuffield Advanced Physical Science Project (See SEN 12.1, 15.2, 17.1, 20.1, 23.3, 23.19.2)

The most recent publications of the Nuffield Advanced Physical Science Project are perhaps in some ways some of the most interesting. They are the "Source Book on Physical Sciences" edited by B E Dawson and "Students Workbook 3, The Options"; both are available from Penguin Education price £5.25 each.

The Source Book is not a textbook in the generally accepted sense. Its purpose is to provide the means for students to become familiar with the activities and thoughts of some practising scientists and technologists on specific topics. The Source Book is intended to complement the various volumes of the Students Workbook for the Nuffield Physical Science Course. Some of the material in the Source Book is drawn from articles prepared for use during the trials of course materials. In the collection some attempt has been made to relate certain aspects of common themes and topics of the Physical Science Course and to reflect current concern for the right use of all scientific knowledge and its subsequent evaluation in relation to specific needs. The material is divided into 11 Sections which include a strong emphasis on materials science (methods of purifying materials, structure of materials, materials and their properties), and the social aspects including a section on pollution.

The 'Options' publication provides opportunities within which students may spend more time on topics in which they are particularly interested, developing further matter which has been treated more generally in the basic course. The Options offered are:

An Introduction to Thermodynamics
Rate Processes
Rotational Motion
The Conduction of Electricity
Methods of Purification and Criteria of Purity
Molecular Spectra and Photochemistry
Further Organic Chemistry
Metals
Polymers
Ceramics and Glasses

It will be noted that 3 of these, - metals, polymers and ceramics and glasses - are very strongly oriented towards materials, reflecting something of the concern for materials science in the basic course.

2. The Chemical Society

Two new Chemical Education publications have recently appeared from the Chemical Society.

The first of these is entitled "Objective Testing - a Workshop Report" and is presented by J C Matthews on behalf of the Joint Committee for HNC and HND in Chemistry and Applied Chemistry. The introduction to the booklet stresses the increasing interest in objective testing in chemistry at college and university level and the demand which this has stimulated for information on how such tests may be designed, constructed and operated. The booklet is an attempt to meet this demand and its contents are based in part on experience gained by a working party set up by the Joint Committee for Higher National Certificates and Diplomas in Chemistry. It emphasises that it is not the purpose of the booklet to criticise traditional methods of examining, nor does the booklet imply that objective testing is the best form of examining. The working party

indeed, would oppose the view that assessment of attainment in chemistry at this level should be entirely in the objective test form. The contents cover: The Design of Tests, Training for Question Writing and Reviewing, Question Banking and Test Assembly, Is Objective Testing Worthwhile? It also includes a useful bibliography and a series of appendices illustrate the matter of the report with specimen question papers and other material.

The second publication is entitled "Chemical Education in Industry" and is a report of a symposium held by the Education Division of the Chemical Society at the University of East Anglia, in September 1973. It considers two elements: Industry's Contribution to Schools Chemistry and Education Within Industry. The publication contains the subject matter of a series of lectures presented at the symposium covering varied subjects such as Industry's Contribution to Schools Chemistry, C J Ball, BP Limited; Coordination of Teachers' Centres, F R McKim, Marlborough College; Operator and Technician Training in the Chemical Industry, P Bennett, Chemical and Allied Industry Training Board; and Initial Graduate Training Scheme, D A A Kidd, May & Baker Limited; as well as items on Graduate Tutorial Schemes and the assessment of Industrial Training, amongst others. This report will be of particular interest both to teachers of sixth form chemistry and to those concerned with professional training in chemistry.

The publications are available from the Education Division of the Chemical Society and enquiries should be addressed to: The Assistant Education Officer, The Chemical Society, Burlington House, London W1V OBN, England. The first report "Objective Testing - a Workshop Report", price £1.00 to members of the Education Division; £2.00 to non-members. The second report "Chemical Education in Industry", price £0.75 to Division members and £1.05 to non-members.

3. The Education and Training of Science Laboratory Technicians in Schools and Colleges

A report is now available on the symposium recently held at the University of Keele which raises issues of immediate concern to science teachers and laboratory staff, headmasters and governors, local authorities, lecturers at further education colleges and those planning teacher centre programmes and indeed to science educators in general. The report on the "Education and Training of Science Laboratory Technicians in Schools and Colleges" highlights two urgent needs:

- for a viable career structure based on 2 basic grades for laboratory staff;

- job specifications to be drawn up without delay as a prerequisite to the more effective use of existing staff and the planning of suitable courses of education and training.

It also suggests means whereby more effective relationships between teachers and laboratory staff can be promoted and pleads for a much fuller recognition of the important supporting role which suitably qualified laboratory staff can provide in the teaching situation. This report has been produced at a time when the newly established Technician Education Council is looking at all aspects of technician education. The report, with additional comments by Dr I F Roberts, Senior Lecturer in Education at Keele, makes an important contribution to discussions which now need to take place throughout the country. Contributors to the symposium included Dr B W V Hawes, HMI, Mr J R Barr, Adviser in Science, Edinburgh Corporation, Mr P F Judson, Lecturer in Charge of Science Laboratory Technicians Course, Mid Herts College of Further Education, Mr H R Stanley, Chairman, ASE Sub-Committee on Laboratory Technicians, Cannock Grammar School and Mr W J Foley, Senior Laboratory Technician, Wolverhampton Grammar School.

The report is available from Mr R P Seymour, Institute of Education, University of Keele, Keele, Staffs ST5 5BG, £0.25 per single copy or £0.20 if 5 copies or more are ordered. Cheques and postal orders should be made payable to the Institute of Education, University of Keele.

4. "Experiments in Radioactivity" - City of London Polytechnic

The Department of Chemistry of Sir John Cass College (now part of the City of London Polytechnic) have for some years conducted short courses for chemistry teachers in the handling of radioactive materials and their use in experimental work. A booklet has recently been informally published as a support document for the courses and could prove an invaluable aid to those teachers involved in advanced sixth form work or the first years of University/Technical College studies.

The introductory section of the booklet outlines the procedures for handling radioactive materials, discusses the units most frequently used during experiments, the handling of data, and methods of measuring radioactivity - chiefly by the Geiger-Müller and Scintillation counting procedures.

There then follow descriptions of a number of experiments within which the purpose, theoretical basis, experimental procedures, results and calculations are all considered. Further relevant and useful text references are offered after each. Topics covered include:

1. Preparation of sources for counting
2. The efficiency of counters
3. Decontamination
4. The decay and growth of protactinium - 234m
5. Extraction of carrier free thorium - 234 from uranyl nitrate
6. Ion exchange as a separation technique
7. Determination of the dissociation constant of barium tartrate
8. Isotope dilution analysis
9. The determination of the solubility and hence the solubility product of a sparingly soluble salt
10. Determination of the partition of a solute between immiscible solvents
11. Rate of exchange of iodine between iodine andiodethane in solution
12. Preparation of labelled amino acids
13. Separation of lead - 212 and bismuth - 212 from thorium - 232
14. The absorption of β-particles
15. Gamma-ray spectroscopy
16. Scintillation counting with phosphors in solution
17. Diffusion cloud chamber
18. Geiger-Müller Dead Time Corrections.

Supplementary Appendices cover tables of count rates corrected for dead time, characteristics of some common radionuclides, tables of decay factors for some short-lived radionuclides, a further select bibliography and some useful addresses.

The booklet is well set out, clearly explained and should form an invaluable aid to teachers involved in experiments in radioactivity.

Unfortunately there may be only limited copies available at nominal charge, but further information may be obtained from Dr B Wiseall, Department of Chemistry, Sir John Cass School of Science and Technology, 31 Jewry Street, London EC3N 2EY.

5. The Nottinghamshire Schools Mode 3 Integrated Science Course

The two main English integrated science courses available at secondary level are the Schools Council Integrated Science Project and the Nuffield Combined Science Project. The former would normally be regarded as suitable for GCE pupils and the latter for CSE pupils. However, the two projects differ in their approach and teachers in Nottinghamshire felt that they would prefer to adapt SCISP for their CSE pupils rather than use Combined Science. This is the reason for the existence of the Nottinghamshire Schools Mode 3 Integrated Science Course.

The course has been produced as a Mode 3 CSE course counting as 2 CSE subjects, and designed to occupy the last 2 years of secondary school. It consists of a core course and a set of modules. The core course counts as one CSE subject and the modules as the other, and they therefore occupy equal amounts of time. The core course is made up of sections devoted to: 1. structure (of matter and living things); 2. the earth; 3. the environment; 4. plants and animals; 5. energy. The modules are of 5 types having a chemical, physical, biological, earth science or technological bias. Examples of physically biased modules are photography, radioactivity, sound and music, flight, ergonomics, science in the home.

The Schools Council has expressed interest in the project.

6. Education Use of Living Organisms (See SEN 15 5, 17.4, 18.43, 19.29)

The first two teachers booklets, "Animal Accommodation for Schools" (£0.60) and "Small Mammals" (£0.75) were published in June by English University Press, St Paul's House, Warwick Lane, London EC4P 4AH.

7. Mathematical Education for Teaching

The third issue of a new journal entitled "Mathematical Education for Teaching" appeared in April 1974. This journal is produced by the Mathematics Section of the Association of Teachers in Colleges and Departments of Education in Britain (ATCDE). The current edition contains articles on:

Mathematics in the BEd Degree by A R Paterson

A Survey by Heads of School Mathematics Departments. Ratings of New Mathematics Teachers by A C Draper

Mathematics in the Middle Years by Sister M T Pinner

Concepts in Mathematics. A Conference Report

The Content of Courses in Mathematics Education (Secondary) by R S Heritage

Piaget in the School Curriculum. Review of an article in the Bulletin of the Ontario Institute for Studies in Education.

This journal is clearly a valuable edition to the current literature on developments in mathematics education. Orders for "Mathematical Education for Teaching" should be sent to the Editor, MEFT, Mathematics Department, Newton Park College, Bath BA2 9BN, England. Subscription rates are as follows: University College or Department subscriptions - 3 copies of each of 2 annual issues - £4.80 per year; single additional copies of both issues £1.00 per year. Individual subscriptions - 1 copy of each of 2 annual issues - £1.70 per year. For accounting purposes subscriptions cover the academic year and in ordering the academic year for which the subscription is intended should be stated.

8. Mathematics for the Majority Continuation Project

A further grant has been made to this project to enable a teacher of partially sighted children to be attached to the team for a year from September 1974 in order to adapt the project's materials for use with visually handicapped pupils. This follows recommendation of the Schools Council's Working Party on Special Education based on the report of the Vernon Committee of Enquiry into the education of the visually handicapped.

The Buildings Pack was published in June by Schofield & Sims at £20, "Communications" will be published in September, also at £20. The present director of the project, Mr Peter Kaner, will be leaving the project in December 1974 to work with the Inner London Education Authority. For its last few months the project will be directed by Norman Pass, who is Head of Mathematics at Northumberland College of Education and has coordinated the project's work in Northumberland, Gateshead and Tynemouth.

9. Mathematics Teaching Aids - Osmiroid Educational

A new edition to the range of teaching aids for schools has recently been introduced by Osmiroid Educational. Each item has been fully tested in the classroom and is manufactured in tough non-toxic materials to the highest standards. Of particular interest is the range of equipment under the "measure and observe" grouping. This is sub-divided into apparatus for the study of time, dimension, volume and weight, measuring, observing, and writing. Full details may be obtained from F S Perry, Osmiroid Works, Gosport, Hampshire, England, who will supply catalogues on request.

10. Mathematical Association Annual Conference

The Mathematical Association held its Annual Conference at Royal Holloway College, University of London, from 8-11 April. Participants from Britain were joined by overseas visitors including representatives from Europe, North America, Egypt and Argentina.

The programme was arranged in a series of plenary sessions followed by working groups. Main themes of the former achieved a balance between the theoretical ("Transcendental Numbers" and "Euclidean Geometry and the Design of Experiments") and more practical aspects of Mathematics teaching ("Mathematics for the Less Able" and "The Sixth Form Curriculum"). Discussion of new sixth form strategies assumed a particular significance in the context of the recent Schools Council proposals to institute a more balanced curriculum of subjects to be taken at N (Normal) and F (Further) levels to replace the existing A-level system. The position of mathematics within this, its content and approach were considered as were the examination syllabi new CEE (Certificate of Extended Education) to be taken by CSE pupils who spend one year in the sixth form.

A choice of some 17 working groups was offered on topics including problem solving, multiple choice questioning, mathematics in the primary, middle schools and sixth form, teacher training and in-service work, mathematics in industry, mathematical attainment, computational aids and the teaching of mathematics through its applications. It is hoped that some of these groups will subsequently produce short articles or pamphlets.

The 1975 conference will be held in Norwich from 2-5 April.

11. Association of Teachers of Mathematics Annual Conference

The annual conference of the Association of Teachers of Mathematics took place in Nottingham from 16-20 April. The programme consisted of a one day seminar followed by a series of shorter working seminars with the emphasis upon activity and experimentation by the participants.

Topics offered for the one day groups included "A Feeling for Topolgy", "What makes a good problem?", "Visual Starting Points", "Assessing Coursework", "Preparation for the Classroom", "The Slow Learner", "Activity in the Primary School", and approaches to Middle School Mathematics teaching. A special Overseas Group was also led by Mr B J Wilson with delegates from Ghana, Argentina, Egypt, Jordon, Malta and Vietnam contributing information on their various educational systems and mathematics curricula. Mutual problems were discussed, ideas exchanged and strategies for future curriculum development in the context of the Developing Countries considered.

Working groups extended the activities of the conference to various specific areas of mathematical teaching such as groups, games, computer education, shape and materials and also took a particular interest in the problems of the slow learner, mixed ability classes and Middle school mathematics. In-service training and Primary mathematics were further extensions.

A variety of informal working groups were convened with the intention of continuing work throughout the year and the ultimate production of informal pamphlets to be published by the ATM.

The 1975 conference will be held in Lancaster from 1-5 April.

ACTIVITIES IN BRITAIN - GENERAL

12. Schools Council Geography 14-18 Project (See SEN 14.8)

The Geography 14-18 Project has recently issued a Schools Council pamphlet entitled "A New Professionalism for a Changing Geography" written by the project team of Gladys Hickman, John Reynolds and Harry Tolley. The aim is to outline the ideas that underlie the mode of working involved, to illustrate how geography teachers are implementing it and to invite support for its wider dissemination.

From its inception Geography 14-18 has had a complementary role in relation to the Geography for the Young School Leaver Project (see SEN 14.8, 18.2, 22.15) whilst also drawing upon similar material in areas which entail the same basic learning strategies. The Young School Leaver Project has placed more emphasis on the production of finished, more closely structured teaching materials with emphasis on short-term requirements less dominated by examination pressures. Geography 14-18, however, has aimed at the more specialist geography pupil with longer term needs and an examination context.

Part I of the pamphlet examines the concept, format, content, and approaches to the 'new geography', and outlines the threefold strategy of the project work. These latter are approximately equally divided between resources, modes of working and organisational support including examinations. The aim linking the three is to develop the ability of geography teachers themselves to make curriculum renewal an integral part of their work. The project believes that an approach to curriculum development which grew up in the 1960s based upon the production, testing and dissemination of packages does not adequately meet the needs of the 1970s. If geography curriculum development is to adapt to continuing change then it must involve teacher development and organisational change.

Part II sets out policies for school-based curriculum renewal and Part III examines the implementation of these in the Project's 10 pilot schools. Examples of coursework, assignments, core syllabi and examination questions are offered with brief curriculum guidelines. The pamphlet concludes with a look towards the future and the hope that schools, local teacher groups and local authorities can be encouraged to extend their present modes of working towards the approaches of the Project. They wish to emphasise the following propositions:

- Teachers need more opportunities to discuss and evaluate ideas if they are to be used more effectively to provide 'intellectually exacting study in geography'.

- The abilities to adopt and to adapt new ideas and to redesign curricula are becoming key skills because changes in the subject will continue.

- Teacher-based curriculum renewal is practical and rewarding when teachers have adequate incentive, feedback and support and can influence the form, pace and assessment of their use of new ideas.

- The extra initial work grows less as:

  a. new skills and roles are learnt;

  b. resource-orientated methods and reprographic facilities enable a re-allocation of teaching time and resources.

- The teacher-based approach to curriculum renewal depends upon organisational support and flexibility, especially between schools and examination boards, which it is not possible for the teachers themselves to bring about.

"A New Professionalism in a Changing Geography" is obtainable from the Project at The School of Education, University of Bristol, Bristol.

NB The 3 main Project Publications should be available in 1974-75:

A Teacher's Handbook to include practical guidelines such as syllabi, assessment programmes, coursework, assignments and individual studies.

Teaching Materials in the form of packs or kits aimed at providing:

a. models on which teachers develop their own units;

b. a starter resource which can be added to consisting of Project-devised materials and school-devised materials.

A Working Paper which will be the main theoretical statement of the project's work and strategy and is expected to be published as a Schools Council Working Paper.

13. The Open University - Technology for Teachers

The Open University are running a post-experience course starting in February 1975 and lasting for 10 months, entitled "Technology for Teachers". The course is designed to help teachers and teacher educators to develop a rationale for introducing technological activity into schools. It aims to provide teachers with a selection of technological topics and to consider methods of teaching and assessing pupils in secondary schools. Further details can be obtained from the Post-Experience Student Office, The Open University, PO Box 76, Milton Keynes, MK7 6AN, England.

14. Environmental Studies Project (See SEN 11.4, 12.8, 14.9, 16.7)

The 16-minute 16mm colour film made by this project and entitled "Environmental Studies 5/13" is now available from the National Audio Visual Aid's Library, Paxton Place, Gipsy Road, London, SE27 9SR, price £97.50.

15. Project Environment (See SEN 18.23)

The first book from this project, "Education for the Environment", a general guide to the series, will be published in the autumn. Four teachers books will follow - "Production Ecology", "Learning from Trails", "The School Outdoor Resource Area" and "Ethics and the Environment" - and the last of these will be accompanied by 9 pupils books and sets of slides. The materials will be published by Messrs Longman's, Longman House, Pinnacles, Harlow, Essex.

16. Scottish (National) Centre for Science, Mathematics and Technical Education (See SEN 23.15, 23.18.11)

The most recent publications of this Centre are:

Memorandum No 13 Electromagnetism for Certificate of Sixth Year Studies, price £0.25;

Memorandum No 14 Oscillations and waves, price £0.25;

Memorandum No 15 Small scale methods in Chemistry, price £0.20.

These are obtainable from the Scottish Centre for Mathematics, Science and Technical Education, College of Education, Park Place, Dundee DDL 4HP, cash with order. Cheques and postal orders must be made payable to Dundee College of Education.

17. Nuffield Group for Research and Innovation in Higher Education (See SEN 23.16, 24.21)

The fourth Newsletter of the Nuffield Foundation Group for Research and Innovation in Higher Education concentrates on new developments in university institutions which the Group has recently visited together with longer reports on topics which have been discussed with interested university teachers at working sessions since September 1973.

The principal sections cover academic structure, developments in inter-disciplinarity, broader education, independence in learning, priorities for funding educational development, and in addition has notes on current developments.

The section on developments in interdisciplinarity is of particular interest and is based partly on a 3-day conference on interdisciplinarity held at Owens Park, Manchester in January 1974. Interdisciplinarity is one of the main new trends in undergraduate education both in universities and polytechnics in Britain and indeed elsewhere. In some areas, particularly the environmental sciences, the idea of interdisciplinarity has achieved considerable credence and acceptance but in other areas too, considerable interest and activity now exists.

The Newsletter now reaches over 1,500 university teachers and other interested persons. The costs of its production have therefore risen considerably and in future there will be a contribution of £0.25 per copy towards the production costs. Further information can be obtained from the Nuffield Group for Research and Innovation in Higher Education, Nuffield Lodge, Regents Park, London NW1, England.

18. PUBLICATIONS

18.1 Certificate Chemistry, Cane and Sellwood, Schofield and Sims, price £1.45

This is the third in a series of 4 books covering both traditional and new GCE O-level syllabuses of British GCE Examination Boards and also the subject content of the Nuffield Sample Scheme. They are adequate also to deal with the content of the alternative syllabus for the ordinary grade of the Scottish Certificate of Education. The material in the books is arranged in teaching units and the units are made as self-contained as possible in order to give the greatest possible assistance to teachers. The units are divided into sections written for pupils to read and enjoy, a section of class experiments or activities together with demonstration experiments where appropriate, a section of follow through material developing the subject theme, a section of written exercises that may be used in class or for homework and lastly a section devoted to teaching aids and references chiefly for the teacher.

Book 3 deals with chemicals and quantities and is divided into 4 sections making 14 units in all. The sections are:

Introduction to mol quantities

Electron transfer and mol quantities

Periodic classification of the elements

Carbon

The books are well illustrated with two-colour diagrams and both black and white and colour photographs. The exercises and sections on teaching aids are, together with experiments and activities, printed in different colours to the text material proper thus making it easy to follow the material. This is a useful addition to the material available for teaching modern chemistry courses.

18.2 Chemistry - Objective and Completion Tests for O-Level, edited by Ernest Clark, John Murray Limited, price £0.60, 1974

This is a further addition to the growing literature on assessment in science subjects. This volume focuses both on the more widely known Objective Test and its adaptation to the Completion Test. Considerable effort has been put into checking the accuracy of each test item and the tests themselves. The chemical nomenclature used has been amended in the second edition in accordance with a recommendation of the report issued by the Education (Research) Committee of the Association for Science Education which is based on IUPAC rules. Oxidation numbers are now used but where necessary the older names are given in parenthesis. Each of the papers in the book is available in a wallet containing 20 or 30 copies of the same paper.

18.3 "Plastics" - Project Technology Heinemann Educational Books, price £2.00

This is the latest in the series of Project Technology Handbooks published by Heinemann Educational Books for Project Technology and deals with another aspect of material science - plastics. The contents are divided into 4 parts: understanding plastics, working with plastics, projects with plastics and references. The section 'understanding plastics' introduces the reader to the vast range of plastics available today. The chemical

structure of plastics largely determines their working properties and these in turn will influence the designers choice. This principle is illustrated. In the second section 'working with plastics' the success of the plastics industry is analysed particularly under the suitability of plastics for mass production methods and looks in particular at equipment for manipulating plastics.

The third section deals with a number of projects involving plastics with a list of 17 design briefs on plastics materials including a model Catamaran, a body for a monorail vehicle and a hydroplane.

The final section contains a miscellaneous group of items including instructions for the construction of crystal models, a list of addresses of resources on plastics together with suppliers and trade names for plastics material. An important item concentrates on safety in the use of plastics and on the storage and care of plastics material. A useful glossary of terms completes the publication.

18.4 Thermodynamics - Topic Book 3, Cosmos Series by A J P Ayres, published by Hutchinson Educational, £1.00, 1974

This book does not intend to be a textbook of thermodynamics. It is written on the assumption that the reader is more likely to be interested in how things work than in a catalogue of phenomena which may or may not be interesting in themselves. Much of the book consists of articles explaining how things work and relating this where appropriate to general principles of theoretical physics. It will form a very useful background book for pupils studying physics at the middle and upper levels of the secondary school. The book is extremely well illustrated both with diagrams and photographs, and the range of processes and operations described is large, going considerably beyond the conventional physics course. This book will be welcomed as a valuable addition to the growing collection of background books for secondary school physics.

18.5 Structure and Metals by M Hudson, Hutchinson Educational, price £2.00

This book is designed to introduce the study of metals and the author has assumed a knowledge of physics and chemistry up to GCE ordinary level. The text deals with fundamental points which are illustrated by carefully chosen diagrams and photographs, all principles are fully explained and experiments have been included at the end of each chapter. It is a parallel book to "Structure and Materials" by the same author. The material is divided into 6 sections:

Imperfections in an essentially perfect structure
Alloys
Iron and steel
Deformation
Fracture.

The book is designed to provide an introduction to physical metallurgy and the author has adopted a descriptive rather than a mathematical approach. The book should be useful at GCE Advanced Level in chemistry, physics or physical sciences and is intended largely for first-year students in higher education.

18.6 Explore and Discover: Science for the Middle Year, Darke and Hughes, McGraw Hill Limited, price £3.50

This book arises out of experience with mixed ability teaching in the first 3 years of a comprehensive school. It is now widely recognised that

science study and activity should form a part of the curriculum for all children in the middle years of schooling, and it is the intention of this book to provide a resource for pupils in this age group. It is intended that the book can be used on its own or to support other materials which have been developed under the auspices of middle school curriculum projects.

The book is oriented towards an experimental approach to science and tries to stimulate a questioning approach in pupils. The now familiar key concepts of energy and life form a strong connecting theme through much of the material and the book is extremely well illustrated with clear diagrams and should be suitable for use by less experienced teachers as well as providing an additional resource for more experienced colleagues. This book is a valuable addition to the comparatively small amount of publishing directed at this particular age group.

18.7 Aims, Methods and Assessment in Advanced Science Education, edited by D E Billing and B S Furniss, Heyden & Son Limited, price £4.00

In the current ferment of discussion on problems in education at the tertiary level this book will provide a valuable source of professional comment and insight. Organised in 4 sections covering objectives, curriculum developments, educational techniques, and assessment methods it consists of some 15 articles by leading figures in this field. In addition, B S Furniss adds a chapter on Developments in Advanced Science Education as a conclusion to the publication while the Appendices include a list of organisations concerned with education together with notes on the contributors themselves.

18.8 Artificial Intelligence - Science Research Council, April 1973, free of charge

This publication consists of a personal review of the field of artificial intelligence by Sir James Lighthill FRS, Lucasian Professor of Applied Mathematics in the University of Cambridge. This report was originally published by the Science Research Council in September 1972. The present publication includes a series of comments on the Lighthill report by Professor N S Sutherland. A third component of the report contains comments from Dr R M Needham, Professor H C Longuet-Higgins and Professor D Michie.

Professor Lighthill's report is divided into 3 categories:

a. Advanced automation

c. Computer-based central nervous system research

and b. that research which may be described as bridging between categories a. and c.

The publication provides an interesting insight into a very rapidly developing field of applied mathematics and technology.

19. SCIENCE EDUCATION ABSTRACTS

19.1 Children's Understanding of the Classification of Living Organisms, D Ryman, Journal of Biological Education (1974) 8(3) 140-144.

Studies of the varicty and classification of living organisms often serve as an introduction to the teaching and learning of biology in secondary schools. The traditional approach was generally one of definition and examples, but the influence of the Nuffield O-level biology project materials (1966) has led to the adoption by many teachers of an inductive approach in which pupils are invited to seek criteria for classification by observation of specimens, photographs and drawings, of a range of organisms. Whatever method of teaching is used, the difficulties experienced by pupils in understanding classification are, suggests the author, often much greater than many teachers anticipate. This article describes an investigation carried out as a part of a broader study of the development of children's thinking in relation to biological education. Over 200 pupils were tested for their ability to name and classify drawings of living organisms. The children were drawn from 5 comprehensive schools and included the full ability range as measured by a standardised test to intelligence. Details of the results of the study are contained in the article. Amongst the conclusions is a suggestion that 12 year old comprehensive school children classify and identify animals much more effectively than expected but their understanding of classification was generally poor. This is related to inadequate concept formation and language problems. The Journal of Biological Education is published by the Institute of Biology 6 times a year. Subscription rates: £4.00 per annum, plus £0.45 postage. Subscriptions from USA, Canada, Central America and Southern America are $10.80, plus $1.20. Subscription orders may be placed with the Institute of Biology, 41 Queens Gate, London SW7 5HU, England.

19.2 An Evaluation of the Nuffield O-level Biology Course Materials and their Use, Part 1, P J Kelly and G Monger, School Science Review, Volume 55, March 1974, No 192, page 470

During the academic year 1970-71 evaluation studies of the Nuffield O-level biology course were undertaken to determine whether a revision of the course was necessary. They provided considerable information which in fact indicated that some aspects of the course would benefit from revision, and this has now been carried out (see SEN 24.1). In this article and the one to follow are reported the more significant generalised findings of this survey.

In 1971 a total of 7,172 candidates from 199 schools in England, Wales and Northern Ireland entered the special Nuffield examination set by the Joint Matriculation Board. It is apparent that this represents only a fraction of the use of the material as a 1968 estimate obtained by the Schools Council suggested that 582 school science departments in England and Wales were using Nuffield biology materials for at least one year. Sales of the book suggest even higher use rates.

This particular investigation was concerned with the use and suitability of course materials, ie books and visual aids and the teaching and learning methods and examinations associated with them. It was essentially a study of the implementation of the course and was only one of the sources of information used in revision exercises. Detailed postal questionnaires were worked out and distributed to the teachers. Books and examination

papers were scrutinised by an independent group of teachers and school visits made to supplement this data. The investigation was designed to answer 8 questions:

For which pupils is the course used?

How do teachers use the course materials for their classes?

How suitable are the materials used in each section of the course for teaching?

What aspects of the course do pupils find interesting, uninteresting and difficult?

How suitable are the course materials for aiding the achievement of the course objectives?

What aspects of the course are covered by the examination?

What is the relative achievement of pupils in different aspects of the examination?

In what ways might the implementation of the course be improved?

A survey of the answers to the questionnaires and its relation to these questions is presented.

The School Science Review is the Journal of the Association for Science Education and is published by John Murray in September, December, March and June. Annual subscription: £5.50, including postage inland or abroad; or free to members of the Association.

19.3 Flourishing Jungle of Mini-Computers, Claire Smythe, New Scientist, 6 June 1974

In the decade since their birth, mini-computers have grown from being simple, slow and limited black boxes into powerful processes capable of being built up into computer systems that can even challenge some of the big main frame machines on their own ground.

This article describes the developments in the mini-computer area over the last 10 years and emphasises the reduction in costs accompanied by improvement in performance and sophistication. It lists 11 British manufacturers making mini-computers and the basic products which they offer and describes the performance of some of the more prominent of these machines.

Larger educational institutions are increasingly taking an interest in the possible acquisition of material of this kind and this article presents a useful analysis for such organisations.

The New Scientist is published weekly by New Science Publications, 128 Long Acre, London WC2E 9QY, England. Annual subscription: £9.75.

OVERSEAS ACTIVITIES

20. AUSTRALIA

National Science Curriculum Materials Project (NSCM)

The materials of the National Science Curriculum Materials Project from Australia have recently become available in Britain. These are published in the British Isles and Europe by John Murray (Publishers) Limited, 50 Albemarle Street, London W1. The NSCM Project has been developed through the Australian Centre for the Development of Learning Material, Macquarie House, Church Street, Ryde, New South Wales. The Project intends to produce some 98 modules representing the work of a large number of science educators in schools, colleges and universities throughout Australia. It is attempting to produce interrelated science materials in Biology, Chemistry, Geology and Physics for the final 2 years of secondary education in all Australian States. It has set a precedent in Australia with a considerable investment by a commercial publisher in producing curriculum material for schools. The Jacaranda Press have invested over a quarter of a million dollars to finance the project. The project began in 1968 and the materials were first published in Australia in 1972. Over 300 people have been involved in the production of the full range of materials offered by the project. In addition to the written material the project has developed slidesets, overhead projection transparencies, card sets, tapes and films related to the books.

Amongst the materials available in Britain at the present time are:

C1 A Chemist's view of the Atom by G C Morris

C2 Chemical Bonding by D Harcourt

C4 Chemical Equations by J N Pendlebury

C6 Chemical Periodicity, Part 1 (Theory) by D W James

C8 Energy in Chemical Reactions by J P Doherty

C9 Rates of Chemical Reactions by R J Stanley

C10 Principles of Chemical Equilibrium by B Craven

C11 Oxidation and Reduction by J F Langrehr

C13 The Chemistry of Carbon, Part 1 by P N Calcraft

P9 Sound Waves by D E Hutchison

P10 Heat Energy. Kinetic Theory by N H Fletcher

P16 Electronics by R G Rowlands

B8 History of Living Things by N Kelly

B9 How Evolution Works by B C James

B10 Population Ecology by B Morley

B12 How Cells Work by G Burnstock

B15 How a Green Plant Works by J Palmer

B18 Reproduction by P J Stanbury

B19 The Evolution of Man, Part 1 by D B Allbrook

B20 The Evolution of Man, Part 2 by D B Allbrook

B21 Animal Behaviour by J Kikkawa

B23 The Parasitic Way of Life by P J Stanbury

Full details are available from John Murray (Publishers) Limited.

21. INDIA

In recent years the programme of Teacher Vacation Courses (or Summer Institutes as they are called in India) in the sciences has been concerned with the pre-university courses and with teaching of early undergraduates studies in the sciences.

In 1974 three such institutes were held under the auspices of the Indian University Grants Committee with British assistance: one each in Physics, Chemistry and Biology. The Biology Course held at the University of Madurai had the services of P J Fry from Southend College of Education for the third year running and Mr W I Stopher of Brockenhurst College for the second year. The Chemistry Course was held at the University of Poona and was assisted for the second year in succession by Dr D J Waddington of the Department of Chemistry at the University of York accompanied on this occasion by H S Pickering of Uppingham School. The Physics Course was held at the Muslim University of Aligarh with the assistance of B Taylor of Rugby School for the second year and also of H W Bradley of the Department of Education, University of Nottingham.

Recently more emphasis has been placed on developing longer term links between Indian and British Science Education Centres. With generous assistance from the Nuffield Foundation Mr Jafri of the Muslim University of Aligarh was able to spend a period on a Nuffield Fellowship attached to the Centre for Science Education, Chelsea College, University of London, working with Mr Ogborn, the previous team leader at Indian Summer Institutes in Physics. Links between the Chelsea Centre and Aligarh as well as Poona are being developed at the present time and it is hoped that these will lead to a fruitful exchange of ideas and of personnel.

22. ISRAEL

The completion of the development of the Science Teacher Education Project (STEP) in Britain and the impending publication of the materials of this project (see SEN 24.2) has stimulated a considerable international interest in its work. Amongst recent overseas activities connected with this was a Science Teacher Education Project Workshop held at Belgium House Hebrew University, Jerusalem from 28 April to 6 May 1974 under the sponsorship of the British Council and the Israel Science Teaching Centre. The purpose of the workshop was to discuss patterns of approach to science teacher education and current methodology in this field and to the new Science Teacher Education Project in its possible implications or applications outside Britain.

The number of participants had originally been limited to 30, but owing to the pressure of demand this was increased to 44. They were drawn from institutions which included the Hebrew University of Jerusalem, Tel Aviv University, Bar Ilan University, the University of the Negev at Beer Sheba, Haifa University and the Teachers Colleges at Jerusalem and Petah Tiquva. Participants also came from the Educational Television Services from the Israeli Ministry of Education Curriculum Centre and from Kibbutzim in the North of the country. Many of the participants are active in curriculum development as well as in training and their subjects of interest included Physics, Chemistry, Biology, Agriculture and Science Education. The Workshop was organised in the Hebrew University by Dr P Tamir.

Three consultants from the Science Teacher Education Project participated in the Workshop under the auspices of the British Council. They were Dr Clive Sutton, project coordinator, from the University of Leciester, Mr Clive Carré of the University of Exeter and Mr John O Head of the Centre for Science Education, Chelsea College, University of London.

STEP materials on the following topics were examined in depth:

Aims and Objectives

The Nature of Science and Scientific Enquiry

The Pupils Thinking

Resources for Learning

Language in Science Lessons

Curriculum Design

Teacher Pupil Interaction

Feedback to Teacher and Pupil

In addition to printed materials some of the supporting audio visual material from the Project was available for the programme by kind courtesy of the publisher, Brunel University, Discourses Limited, Schools Broadcasting Council and McGraw Hill (UK) Limited.

An immediate positive result of the Workshop was the decision to set up two "Resources" groups to investigate the establishment of an Israel Science Teacher Education Project (ISTEP). It is anticipated that working groups may be set up to consider such tasks as the translation of some of the STEP students worksheets into Hebrew; the generation of local resource materials including local films, film loops, video tapes and audio tapes; and the extension of the STEP approach in directions appropriate to the Israeli context, eg utilisation of the Educational Television Service for production of dissemination of in-service training materials.

23. International Studies in Evaluation - Science Education in 19 Countries

The International Association for the Evaluation of Education Achievements (IEA) had its origins at the end of the 1950s when researchers from a dozen countries convened under UNESCO auspices and decided to launch a Feasibility Study with the aim of finding out whether cross-nationally valid achievement tests could be developed and administered uniformly to school children in many different educational systems. The experiences from the Feasibility Project were encouraging and it was therefore decided to embark upon a major survey of mathematics in 12 countries where probability samples of students would be examined. After the completion of the mathematics survey and some exploratory work, the cooperating research institutions decided in 1966 to embark on a new venture, the so-called Six Subjects Survey which proceeded in two main phases under separate research projects. The first phase covered instrument construction, which took place from 1966 to 1969. The second phase comprised of field testing and analysis of data which took place from 1970-73.

Subjects covered by the survey are science, literature, reading comprehension, English and French as foreign languages and civic education. It will be noted that together with mathematics, these subjects cover practically all the principal academic subjects in the secondary curriculum apart from the classical languages. Various age levels were studied in the Six Subjects Survey and they have been defined as follows:

Population: 1

All students aged 10.0, 10.11 years at the time of testing.

Population: 2

All students aged 14.0, 14.11 years at the time of testing.

Population: 4

All students who were in the terminal year of those full-time secondary education programmes which were either pre-university programmes or programmes of the same length.

Population: 4S

All students in Population 4 were regarded within their own systems as specialising in the particular subject being tested.

The results of the analysis in the field of science education are contained in a publication entitled "Science Education in 19 Countries" by L C Comber and J P Keeves and published by John Wiley & Sons.

The countries covered by the report are: Australia, Belgium (Flemish), Belgium (French), Chile, England, Federal Republic of Germany, Finland, France, Hungary, India, Iran, Italy, Japan, Netherlands, New Zealand, Scotland, Sweden, Thailand, the United States.

Analysis of the contents of the publication reveals that it goes well beyond a mere description of science teaching in the different countries although this is of course included. Analysis results include comments on science curriculum and student performance, factors associated with differences between countries and achievement in science and factors associated with between student differences in science achievement amongst others. The instruments used for

measurement are described in some detail. This publication is a valuable addition to the comparative literature on science education. The Headquarters of the International Association for the Evaluation of Educational Achievements (IEA) are in Stockholm. Publications relating to the other subjects being covered by the survey will appear in due course.

24. British Council Course No 328 - "Curriculum Development in Secondary Mathematics"

A 2-week course entitled "Curriculum Development in Secondary Mathematics" took place in April at Nottingham University under the guidance and organisation of Professor J V Armitage and his staff of the Shell Centre for Mathematical Education. Twenty-nine participants represented 20 different countries including Australia, Austria, Canada, Cyprus, Denmark, Egypt, Finland, Germany, Ghana, Hong Kong, India, Irish Republic, Italy, Jordan, Kuwait, Malta, Norway, Peru, Poland and South Africa. All were actively involved in mathematics education either as teachers, teacher-trainers or as members of the Inspectorate.

The course received speakers and information from all the major British mathematics curriculum projects ranging from the School Mathematics Project to the Mathematics Curriculum Critical Review Project. Consideration was given to the broad issues of curriculum content and approach at all levels from the primary to teacher-training and the problems of reform and development and how these might be effected. Attention was paid to the mathematical requirements of scientists, engineers and the medical profession with ensuing discussion on the incorporation of these into syllabus design and subject integration. Several useful sessions were devoted entirely to workshop activities in an attempt to take a fresh look at the procedures and approaches to problem solving and how these might be fruitfully incorporated into classroom activities. Games and materials were explored together with the possibilities presented by the use of television and computers. All these activities were supplemented by afternoons of visits to local primary and secondary schools, a teachers' centre and to Bishop Lonsdale College of Education, Derby, where an in-service course for primary teachers was in progress.

Despite the very full and exacting programme, time was still available for discussion each day and members presented short papers on their own country's mathematics curricula. In this manner common problems were shared, the course information related to individuals' needs and possible future strategies for curriculum development considered. It is hoped that the course will have provided a good starting point and wide base from which the participants will be able to develop and implement ideas appropriate to their various situations and requirements.

25. European Seminar on Mathematics Education - Chelsea College, London

A European Seminar on Mathematics Education entitled "Mathematics Education in the 1980s - Opportunities for European Collaboration" was held at Chelsea College, London University, from 23-26 April. Organisation of the seminar was undertaken by Professor Geoffrey Matthews of the Shell Centre for Mathematics Education, Chelsea College, in collaboration with the British Council and it was intended that this should form a successor to the highly successful seminar "Science Education in the 1980s" held in 1973 (see SEN 22.25).

Approximately 60 delegates attended from Britain, Belgium, Denmark, Finland, France, Germany, Hungary, Malta, the Netherlands, Norway, Poland, Spain, Sweden, Switzerland and Turkey. All were involved in mathematics education at a variety of levels from secondary upwards and the chief objectives were to discuss long-term future developments in a European context.

The seminar followed the format of a few lead papers, but with the majority of the work being conducted in small group discussions. Plenary sessions were as follows:

"Mathematics Education Today" - Professor H B Griffiths of Southampton University;

"Computing in Mathematics Education" - Professor R Gunzenhäuser of Institut für Informatik, University of Stuttgart, West Germany;

"Education in the 1980s - Dr E W H Briault of Inner London Education Authority;

"Continental Traditions and Reforms" - Mr W Servais, Belgium;

"National Objectives-Possibilities of Collaboration" - Professor B Christiansen, UNESCO.

Chairmen and commentators included Dr C Butler, FRS, of the Nuffield Foundation; Professor S J Eggleston of the University of Keele; Dr B Thwaites, Director SMP; Professor Sir Hermann Bondi, KCB, FRS, FRAS; Dr J Howlett, CBE, Director Atlas Computer Laboratory; and the conference dinner address was given by Professor Sir James Lighthill, FRS of Cambridge University.

Group discussion followed each plenary session and although no formal guidance was imposed, each group approached the topics at different levels and emphasised different aspects. Some, for example, chose to view each problem from a teacher-training angle, others were particularly interested in the future of computer education and computers in education, whilst further groups discussed overall aims and objectives in developing mathematics curricula. Mutual problems were shared and the extent to which European collaboration might assist in development explored. A summary of each group discussion was presented to the entire conference during the final afternoon.

It is intended that a synthesis of all plenary sessions and group discussion reports will shortly be published in the International Journal of Mathematics Education in Science and Technology. (John Wiley and Sons).

26. European Conference on the Use of Living Organisms, The Hague, Netherlands, 6-10 May 1974

This conference was the second to be held by the Educational Use of Living Organisms Project, following that held in Chelsea, London in April 1972. Its chief aims were:

- To assess the educational values in the use of living organisms.
- To discuss the use of organisms within their environment, to examine the problems related to the use of ecological gardens and of field centres. To recommend ways, appropriate at a national and also at an international level by which these facilities may be effectively used and the associated problems diminished.
- To discuss the practical aspects of the use of living organisms in education.
- To initiate an international exchange of information and ideas related to the educational use of living organisms.

The conference programme consisted of a series of group discussions and visits including Amsterdam Zoo, Botanical Gardens, school gardens, children's farms, and natural sand dune habitats.

At the final session the following resolutions were adopted:

1. We believe that the study of living organisms is of value to all people and should form an essential theme in the educational process. Furthermore we believe that these studies are of particular personal and social relevance and are vital for environmental awareness.

2. We recommend that every encouragement should be given to the study and wise use of living organisms in and out of school.

3. We recognise that this can be done for instance by the development of field centres, and of natural areas in urban surroundings, which are educationally orientated; school and children's garden services; informative public gardens with resource collections of living material, and supply and support units either commercial or locally based.

4. We recommend that there must be adequate facilities for the initial preparation and further professional development of teachers in the maintenance and use of living material and a wider provision of suitably trained technical assistants.

5. We recognise that the above will require considerable financial support and recommend that it be given because of the importance for man to live in harmony with the environment of which he is a part.

6. We recognise the need for international cooperation in this field and recommend that steps should be taken to develop this. We believe that one of the most important means is to disseminate existing information and that this needs a resource centre and suitable channels of communication to be created.

7. We propose that as a follow up to this Conference another will be organised in 1976 with a focus on the practical problems and effects of using living organisms at secondary school level. At this Conference a report on the implementation of resolution 6 will be presented.

Further information may be obtained from Mr John Wray, Centre for Science Education, Chelsea College, Bridges Place, London SW6, England.

27. Guinness Awards for Science and Mathematics Teachers (Overseas) 1974

The annual ceremony of the Guinness Awards for Science and Mathematics took place in the Guinness Park Royal Brewery on 20 June 1974 Winners in the various sections received their awards from the Countess of Longford and the Eleventh Annual Lecture was given by Dr Royal Strong, FSA, Director of the Victoria and Albert Museum.

Award winners from overseas were as follows:

Joint First:	Miss S K Pang	Malaysia	"Integrated Science Education in a Malaysian Context"
Joint First:	Miss G Mansah	Ghana	"Some suggested techniques for teaching selected topics in the Lower Primary Science Programme"
Third:	Mr I Ninfaakang	Ghana	"Laying the foundations of science education in a primary school".

The following were commended:

Mr A E Coker and colleagues	Sierra Leone
Mr K A K Dodor	Ghana
Mr H M Ghouse	Malaysia
Mr N C Haji	Tanzania
Mrs H C Seaton and colleagues	Jamaica
Mr K S Tan	Malaysia

The committee have reached a decision that 1975 will be the final year for the Guinness Awards in their present form. Information and application forms for 1975 will shortly be available at British Council Offices overseas.

28. ICMI-IDM Conference on the Teaching of Geometry, September 1974

The International Committee on Mathematics Instruction (ICME) and the Institute for Didactics of Mathematics, University of Bielefeld (IDM) are jointly preparing a regional international conference on the teaching of geometry during the period 16-20 September. The conference will take place in Bielefeld, West Germany and will consist of plenary sessions followed by discussion in groups on aspects of geometry teaching at all levels. Opportunity for international exchange of ideas and experiences will be guided by experts from Belgium, Britain, Germany, Hungary, Italy, Netherlands, Poland and Romania.

Further information and application forms may be obtained from: Universität Bielefeld, Institut für Didaktik der Mathematik, D 4801 Jöllenbeck, Heidsieker Heide 94, West Germany.